

Deuterons and space-momentum correlations in high energy nuclear collisions

N. Xu, B. Monreal, S. Panitkin†, R. Snellings, S. Voloshin, and F.Q. Wang*

For a given colliding system and within the same kinematic region, one observes ¹ that the slope parameter T depends on the particle type: the higher the particle mass, the larger the slope parameter. This mass dependence is the strongest for the heaviest systems (Pb + Pb), and vanishes altogether in p+p collisions at similar energies. In any collision, the space-time structure and its correlation with momentum are determined by the underlying dynamics. The above observations are interpreted by considering hydro-type collective flow, which clearly leads to space-momentum correlations (Ref.1).

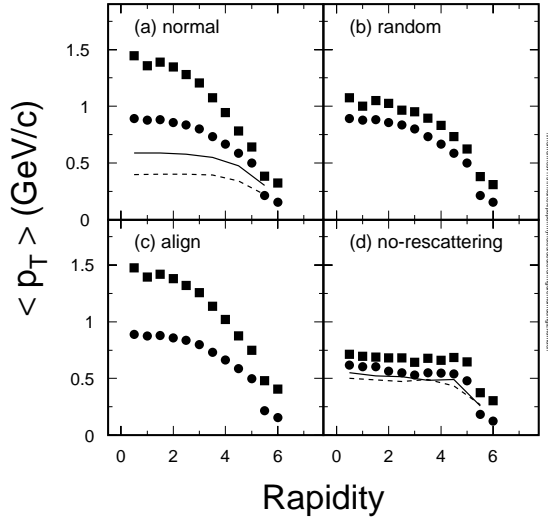


Figure 1: Deuteron (filled square), nucleon (filled circle), kaon (solid-line), and pion (dashed-line) mean transverse momentum $\langle p_T \rangle$ as a function of rapidity. The RQMD calculations are for Au+Au central collisions at $\sqrt{s} = 200$ AGeV.

Some insight into transverse collective flow can

be gained from studying the mean $\langle p_T \rangle$ of single particles, specifically, by observing how does the mean $\langle p_T \rangle$ vary with particle mass. But the full space-momentum structure of the collision cannot be extracted from single-particle momentum spectra along. The spatial information must be included in the study. In this work, we study the transverse momentum distributions of light hadrons as a function of rapidity for the central 100 AGeV Au + 100 AGeV Au ion collisions. The transport model RQMD(v2.4)² and a coalescence after-burner³ was used. Figure 1 shows the mean transverse momentum as a function of rapidity for several particle. In the normal case, Fig.1 (a), the values of $\langle p_T \rangle$ depends on the mass of each particle and the difference in $\langle p_T \rangle$ is also proportional to the particle mass; whence the correlation between the space vector and momentum vector is destroyed, such relationship is altered, see Fig.1 (b) and (c). When the rescattering is switched off, see Fig.1 (d), the $\langle p_T \rangle$ for all particles clap together. At mid-rapidity the nucleon number of rescatterings are $N_c \approx 12$ and $N_c \approx 2$ for normal and non-rescattering calculations, respectively. This implies that a large number of rescatterings leads to the space-momentum correlation at freeze-out and is responsible to the collectivity observed in transverse momentum distributions. Should new physics occur at RHIC energy, a modification of the space-momentum structure will manifest itself in the deuteron yields and the transverse momentum distributions. Note that these distributions can be measured in the STAR TPC and other RHIC experiments.

Footnotes and References

*Physics Department, Yale University

†Department of Physics, Kent State University

¹I. G. Bearden *et al.*, (NA44 Collaboration), Phys. Rev. Lett **78**, 2080(1997); Quark Matter '97 proceedings, Nucl. Phys. **A638**, 1c(1998).

Footnotes and References

²H. Sorge, Phys. Rev. **C52**, 3291(1995).

³J. Nagle, B. Kumar, M. Bennett, G. Diebold, J. Pope, H. Sorge, and J. Sullivan, Phys. Rev. Lett. **73**, 1219(1994).